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Farm Pesticide Supply-Demand Trends, 1982

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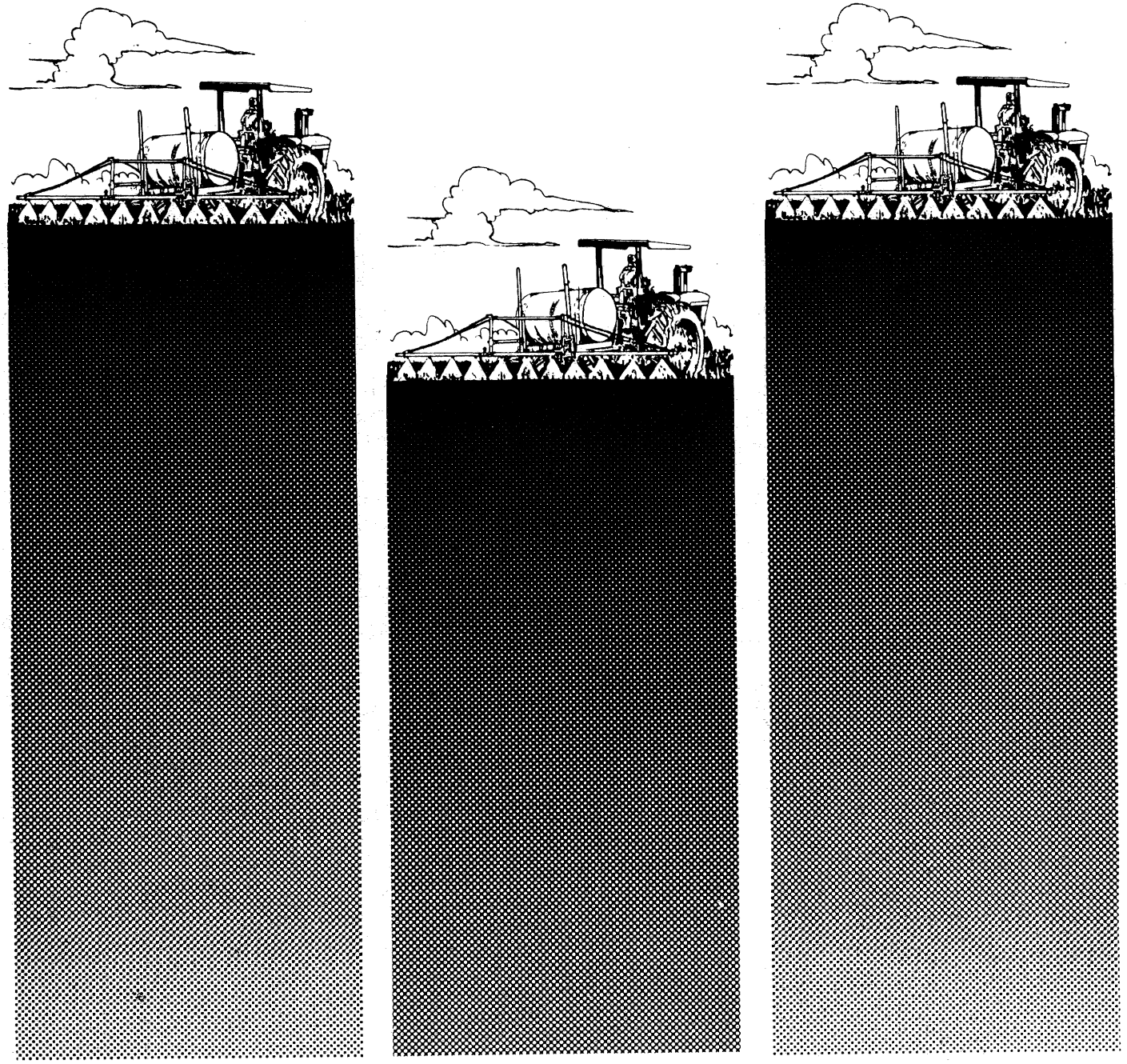

FARM PESTICIDE SUPPLY-DEMAND TRENDS, 1982. By Theodore R. Eichers and William S. Serletis. National Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 485.

ABSTRACT

Pesticide demand in 1982 should be down less than 5 percent from last year. Manufacturers report price increases of 6 to 8 percent to their distributors, but plentiful supplies and weak demand should hold farm price increases to only 5 percent over last spring. Pesticide production should increase 11 percent, satisfying both domestic and export demand for 1982.

Key words: Pesticides, herbicides, insecticides, pesticide supplies, pesticide demand

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife -- if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

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SUMMARY

Manufacturers report 1982 price increases of 6 to 8 percent to their distributors, but plentiful supplies and weak demand should hold farm price increases to only 5 percent over last spring. Pesticide production should increase 11 percent over last year, satisfying both domestic and export demand for 1982.

Total pesticide demand in 1982 should be down less than 5 percent, depending on the degree of participation in the announced acreage reduction programs. Herbicide use will probably drop less than 5 percent. Insecticide use is likely to drop about 5 percent.

Development of more effective chemicals is resulting in a decline in the amount of pesticides needed for some crops. Other developments include increased use of herbicide mixtures, herbicide tank mixes, post-emergence weed control chemicals, and reduced-tillage and no-tillage practices, and more adoption of pest management programs.

Pesticide regulations are being reviewed and in some cases relaxed to promote greater pesticide availability and reduce pest control costs. In the reregistration process, only one final Rebuttable Presumption Against Registration (RPAR) was issued in 1981, compared with four in 1980.

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INTRODUCTION

Farmers are expected to pay about 5 percent more and buy about 2 to 5 percent fewer herbicides and insecticides in 1982 than last year. This report provides current market and 1982 crop season outlook information on farm pest control. Emphasis is on pesticide supply and demand, availability and use of pesticide alternatives, and effects of Government regulation.

The pesticide supply data are based on information obtained from 12 basic pesticide manufacturers who account for over half of the farm pesticide production, and from regional pesticide distributors. The demand discussion is based on U.S. Department of Agriculture (USDA) 1982 crop planting forecasts and on farm survey data on acres treated and application rates. Information on pesticide regulations and alternative controls is based on information from the U.S. Environmental Protection Agency (EPA), USDA, and other sources.

PESTICIDE SUPPLY AND DEMAND

Ample supplies, modestly declining pesticide purchases, and slight price increases are anticipated for 1982.

Supplies

Supplies of all types of pesticides should again be adequate for the 1982 crop season. Manufacturers report planned production of pesticides for 1982 at 11 percent above 1981 (table 1). However, with a modest drop in inventory carryovers and a slight increase in exports anticipated, net domestic supplies are projected at 5 percent over last year.

Herbicide supplies for 1982 are expected to be up 6 percent from last season, with production up 18 percent and inventories dropping slightly. Insecticide supplies are expected to be 5 percent greater than last year, with a 2-percent increase in production and a 12-percent increase in carryover stocks. Fungicide supplies are expected to be down 1 percent.

Because of increased production plans, facilities are expected to be operating at 80 percent of capacity, compared with 73 percent in 1981 (table 2). Most of the increase is the result of a higher output rate for herbicide facilities, which are

Table 1--Pesticide production and inventories

Item	Fungicides	Herbicides	Insecticides	All pesticides
		Percent		
Projected 1982 production (percentage of 1981)	103	118	102	111
Inventory carryover: For 1982 (percentage of production) 1/	14	30	41	29
Change from 1981	-24	-3	12	-1
Projected 1982 net supply (percentage of 1981)	99	106	105	105

1/ Inventories at the start of the 1981 and 1982 season are based on production in 1980.

Source: Based on a survey of 12 basic pesticide producers conducted in October-November 1981.

expected to be operating at 84 percent of capacity, compared with 74 percent last year. Producers reported plans to expand new herbicide plant capacity by 4 percent and insecticide plant capacity by 7 percent in 1982.

Demand

Overall pesticide demand is expected to be down about 2 to 5 percent from last season. Pesticide demand is related directly to crop acreages and pest conditions. Farmers purchased about 750 million pounds of pesticides last year. If a substantial number of farmers participate in the crop acreage reduction programs announced recently, crop acreage could be down 5 percent or more.

Table 2--Pesticide production capacity utilization and capacity expansion

Pesticide	Production as a percentage of capacity		Capacity expansion percentage change	
	1981	Projected 1982	1980-81	1981-82
	Percent			
Fungicide	68	70	0	0
Herbicide	74	84	3	4
Insecticide	72	68	0	7
All pesticides	73	80	2	5

Source: Based on a survey of 12 basic pesticide producers conducted in October-November 1981.

Last year's low farm income coupled with poor income prospects for 1982 should not lower pesticide demand significantly, as pesticides represent less than 10 percent of farmers' budgets for most crops. Consequently, most farmers will use the pesticides at standard rates even with higher prices rather than risk losing a substantial crop investment to pests.

Insecticides

After 2 years of light demand, use of insecticides increased in 1981 due to heavier insect infestations caused by a return to normal moisture conditions in much of the United States, particularly in the South. With normal infestations and a slight drop in crop acreage anticipated insecticide sales in 1982 should be down, probably about 5 percent from last year. Severe winter conditions in parts of the country should have reduced insect populations, lessening insect pressure this year and resulting in a further drop in insecticide demand.

The introduction of synthetic pyrethroids in the last 4 or 5 years has reduced the number of insecticide sprays required for cotton. Because of their mode of action and a longer

residual life, synthetic pyrethroids can be applied much less frequently than the traditional chemicals such as toxaphene, methyl parathion, and EPN. As a result of extensive use of synthetic pyrethroids and participation in integrated pest management programs, quantities of insecticides used in controlling cotton insects have dropped substantially in the last 3 or 4 years.

Herbicides

An estimated 12 percent of U.S. crop production valued at over $12 billion is lost to weeds each year (3). 1/ The combined cost of weed control and lost production amounts to an estimated $18 billion a year.

Herbicide use in 1982 should also be down, but probably less than 5 percent from a year ago. Demand for herbicides during the coming year will depend heavily on the acreages grown for the major field crops. Herbicides account for about 60 percent of the total U.S. pesticide demand today compared with only one-third in 1966. Around 85 percent of herbicides by weight are used on four major crops: corn, 53 percent; soybeans, 21 percent; wheat, 6 percent; and cotton, 5 percent. With significant participation in the crop acreage reduction programs, acreage of these crops is expected to be down somewhat from a year ago.

Fungicides

Fungicides in 1980 accounted for only about 6 percent of the total U.S. dollar value of pesticide purchases. Fungicide demand depends largely on disease levels, which in turn depend on humidity and temperature. The major crops on which fungicides are applied are peanuts, vegetables, and fruits. Rather constant fruit and vegetable acreage and major reliance on routine spray schedules assure a fairly stable demand.

Types of Pesticides Marketed

There have been some significant shifts in types of herbicides and insecticides used by farmers in recent years.

Insecticides

Synthetic pyrethroids have become important insecticides in recent years, primarily for cotton. Although they currently comprise less than 5 percent of the U.S. insecticide market, some analysts estimate that use may double by 1985 (10). However, other specialists indicate further growth may be limited as some insect species are beginning to show resistance to the pyrethroids.

A major advantage of pyrethroids is their effectiveness in controlling specific insect pests with a minimum of harm to beneficial insects. This can represent a significant saving for farmers, as more insect pests can be controlled by natural predators, which reduces the need for chemical pesticides.

1/ Underscored numbers in parentheses refer to items listed in the references.

Mixing the pyrethroids with vegetables oils instead of water reportedly improves their efficacy and efficiency. In the Rio Grande Valley, 0.1 pound per acre of pyrethroids (typical rate is 0.2 per acre) applied with a quart of vegetable oil in ultra-low volume (ULV) application achieved good cotton insect control (7). The oil provides better adherence of the chemical to the plant and thus a longer period of control.

Herbicides

More than 95 percent of herbicides produced today are synthetic organic compounds. The herbicides most commonly used have been atrazine to corn, alachlor and trifluralin to soybeans, 2,4-D to wheat, and trifluralin and flurometuron to cotton. Manufacturers within recent years have introduced a number of new products because some weeds have, through selection, developed a tolerance to some of these compounds.

Many herbicide products are complementary--that is, they perform more effectively when used together. This is especially evident in the corn herbicide market. The effectiveness of atrazine in combination with other products may limit substitution of other products for atrazine.

Most of the herbicides currently marketed are products applied for preemergence treatment of potential rather than observed weed outbreaks. Many of the new herbicide products currently in the development stage are intended mostly for postemergence use. The market for products applied at the postemergence stage is expected to quadruple by 1985 (3). More new products in development can be applied either pre- or postemergence on several crops, and many are effective against a wider array of weed species. Some have also been demonstrated effective for use in no-till programs.

Manufacturers are now formulating a number of herbicide mixtures for problem weed situations. Farmers and dealers also prepare tank mixes of a number of herbicide products. Such mixtures can be more effective than single chemical applications in controlling a broader array of weed species (3).

Prices

Manufacturers are reporting price increases of 6 to 8 percent to their distributors for 1982, but because of plentiful supplies and weak demand, farm pesticide prices are expected to increase only about 5 percent from last spring.

Prices of Pesticide Products

Pesticide prices in 1981 averaged slightly more than 10 percent above 1980. That increase was about equal to the rate of inflation. Herbicide prices were up an average of 11 percent, insecticides up 12 percent, and fungicides up 6 percent in 1981 (table 3). There were, however, noticeable differences in rates of change for various products. The price of atrazine

Table 3--Average prices paid by farmers for selected pesticides

Product 1/	Price per pound (active ingredient)			Price change	
	1979	1980	1981	1979-80	1980-81
	--- Dollars ---			--- Percent ---	
Insecticides:					
Carbaryl	2.56	2.86	3.25	12	14
Malathion	2.76	3.17	3.43	15	8
Methyl parathion	2.24	2.28	2.45	2	7
Parathion	2.80	3.00	3.30	7	10
Toxaphene	1.02	1.26	1.32	24	5
Carbofuran	NA	7.84	9.00	NA	15
Synthetic pyrethroids	NA	NA	68.00	NA	NA
Average	--	--	--	10	12
Herbicides:					
Atrazine	2.47	2.32	2.83	-6	22
Alachlor	3.93	4.04	4.41	3	9
Trifluralin	6.30	7.00	8.20	11	17
2,4-D	1.94	2.93	2.48	51	-15
Butylate	NA	2.80	3.22	NA	15
Average	--	--	--	7	11
Fungicides:					
Zineb	1.88	2.27	2.44	21	7
Captan	2.74	3.36	3.60	23	7
Average	--	--	--	22	6

NA = not available.
-- = not applicable.
1/ Carbaryl, 80 percent wettable powder; malathion, 5 pounds per gallon; methyl parathion, 4 pounds per gallon; toxaphene, 6 pounds per gallon; carbofuran, 10 percent granule; synthetic pyrethroids, 2.0 to 3.2 pounds per gallon; atrazine, 80 percent wettable powder; alachlor, 4 pounds per gallon; trifluralin, 4 pounds per gallon; 2,4-D, 4 pounds per gallon; butylate, 6.7 pounds per gallon; zineb, 75 percent wettable powder; and captan, 50 percent wettable powder.

Source: (18).

jumped 22 percent after having dropped each year since its patent expired in 1976. Distributors, however, are reporting some price cuts for atrazine in 1982. The price of 2,4-D dropped 15 percent last year after a 51-percent increase in 1980.

Alachlor, which is used on corn as well as soybeans, experienced a more moderate price rise than did atrazine between 1980 and 1981. Alachlor maintains a large share of the herbicide market for corn but is facing competition from a number of new products in the soybean market.

Trifluralin is used mostly to control weeds in cotton and soybeans. Trifluralin prices increased substantially during 1979-80 and again during 1980-81. There are, however, a number of effective competing products in both the cotton and soybean markets which should moderate price increases for this pesticide.

Among the fungicides, price increases for both zineb and captan moderated quite a bit from over 20 percent in 1979-80 to less than 10 percent in 1980-81.

In the cotton insecticide market, price increases for established products such as methyl parathion, EPN, and toxaphene and combinations of these materials appear to be moderating (table 3). Toxaphene prices increased only 5 percent between 1980 and 1981, following a 24-percent increase during the 1979-80 period.

Methyl parathion, which also held a dominant share of the cotton insecticide market, experienced moderate price increases during the 1979-81 period. However, price increases for methyl parathion were less than those for other insecticides.

Pesticide Prices Compared to Other Inputs

During 1971-81 pesticide prices went up much less than for other production inputs. During the 10-year period, pesticides prices increased only 78 percent, while input prices in general rose 217 percent (table 4). Interest rates rose 391 percent; fuel and oil prices, 302 percent; and machinery prices, 207 percent during the same period. As a result of the lower price increases, quantities of pesticides used nearly doubled while fuel and fertilizer use increased only a third and machinery sales were unchanged.

Farm Pesticide Use and Costs

Farm pesticide use, which increased dramatically in the sixties and early seventies, is leveling off. Pesticide costs may range from 2 to 15 percent of total production expenses in 1982.

Table 4--Indices of prices paid for input items

Input item	Price index 1914=100		Price change 1971-81
	1978	1981	
			Percent
Manufactured inputs:			
Fertilizer	134	383	186
Pesticides	274	489	78
Machinery	588	1,807	207
Fuel and oil	190	763	302
Total	NA	NA	NA
Inputs produced on farm:			
Feed	224	490	119
Livestock	483	991	105
Seed	294	893	204
Total	NA	NA	NA
Interest	693	3,401	391
Hired labor	1,139	2,588	137
Other production items (including interest and wages)	399	1,039	160
Total production items	328	1,042	217
All farm commodities	281	591	110

NA = not available.

Source: (18).

Treatment Costs Per Acre

Pesticide treatment costs for major field crops continued to increase in 1981 on a per acre basis. Projected average pesticide treatment costs in 1981 ranged from $2.79 an acre for wheat to $86.06 an acre for peanuts (table 5). While pesticide costs are up nearly one-fourth since 1978, they continue to decrease relative to the cost of other inputs. Between 1978 and 1981, pesticide costs as a share of total production costs (exclusive of land) dropped from 7.4 percent

to 6.4 percent for rice, from 17.0 percent to 15.7 percent for peanuts, and from 13.5 percent to 11.4 percent for cotton.

Table 5--Costs of pesticides for producing selected U.S. crops

Crop	Expenditures per acre 1/		Share of total production costs	
	1978	Projected 1981	1978	Projected 1982
	---Dollars---		---Percent---	
Corn	13.15	17.62	8.8	7.2
Sorghum	6.25	8.52	6.4	5.3
Wheat	2.12	2.79	2.9	2.3
Rice	20.84	28.22	7.4	6.4
Soybeans	12.51	16.87	12.6	11.3
Peanuts	64.10	86.06	17.0	15.7
Cotton	35.27	46.34	13.5	11.4

1/ Exclusive of land.

Source: (19).

Survey Results

According to farm pesticide use surveys conducted by the Economic Research Service, growers representing about 90 percent of U.S. corn and soybean production applied 210 million pounds of herbicides to corn and 114 million pounds to soybeans in 1980 (table 6). These growers applied 36 million pounds of insecticides to corn and 8 million pounds to soybeans. Between 1971 and 1980, herbicide use increased 114 percent on corn, and 245 percent on soybeans. Insecticide use increased 63 percent on corn and 57 percent on soybeans during the same period. A major share of these increases, however, occurred between 1971 and 1976, with a much more gradual increase in

the last few years. For example, herbicide use on corn nearly doubled between 1971 and 1976, but rose only 12 percent between 1976 and 1980.

Table 6--Pesticide use on selected U.S. crops, selected years

Crop and type of pesticide	Quantities used			Percentage change		
	1971	1976	Selected years 1/ (active ingredients)	1971-76	1976-80	1971-80 1/
	---Million pounds---			---Percent---		
Corn: 2/						
Herbicides	97.7	181.4	209.5	90.8	12.4	114.4
Insecticides	22.3	28.8	36.4	29.2	26.4	63.2
Soybeans: 3/						
Herbicides	33.2	74.6	114.4	124.7	53.4	244.6
Insecticides	5.1	7.3	8.0	43.1	9.6	56.9
Apples 4/	9.2	NA	10.1	NA	NA	9.8
Citrus	13.0	NA	16.1	NA	NA	23.8

NA = not available.

1/ Data for corn and soybeans are for 1980, apples for 1978, and citrus for 1977.

2/ Represents 90 percent or more of U.S. corn acreage and pesticide use for all 3 years.

3/ Represents 92 percent or more of the U.S. soybean production and pesticide used for all 3 years.

4/ Does not include California.

Sources: (1, 8, 12, 13, 14, 21).

Pesticide use on fruits increased much less than on corn and soybeans during the seventies. Pesticide use on apples increased about 10 percent between 1971 and 1978, while pesticide use on citrus fruit increased about 24 percent between 1971 and 1977.

Pesticides used on corn and soybeans changed considerably between 1971 and 1980. Atrazine, while maintaining the leading position as a corn herbicide, dropped from 48 percent of the

market (quantities of active ingredients) in 1971 to 34 percent in 1980 (table 7). Alachor jumped from 8 percent of the corn market in 1971 to 22 percent in 1980. For soybeans, alachlor increased from 18 percent of the market in 1971 to 29 percent in 1980, while chloramben dropped from 26 percent in 1971 to 4 percent in 1980 (table 8). Carbofuran increased from 11 percent of the corn insecticide market in 1971 to 24 percent in 1980, while aldrin dropped from 31 percent in 1971 to none in 1980, as a result of banning farm use in 1975.

Table 7--Pesticide use on U.S. corn

Type of pesticide	Quantities used (active ingredient)		Share of total quantity	
	1971	1980	1971	1980
	Million pounds		Percent	
Herbicides:				
Atrazine	46.8	72.0	47.9	34.4
Alachlor	7.6	46.0	7.8	22.0
Butylate	5.2	44.5	5.3	21.2
2,4-D	8.2	6.0	8.4	2.9
Dicamba	.3	2.4	.3	1.2
Cyanazine	NA	16.6	NA	7.9
Metalachlor	NA	7.5	NA	3.6
Others	29.6	14.5	30.3	6.8
Total	97.7	209.5	100.0	100.0
Insecticides:				
Carbofuran	2.4	8.8	10.8	24.2
Phorate	2.4	3.6	10.8	9.9
Terbufos	NA	9.3	NA	25.5
Fonofos	NA	7.1	NA	19.5
Chlorpyrifos	NA	2.9	NA	8.0
Aldrin	6.9	1/	30.9	.0
Others	10.6	4.7	47.5	12.9
Total	22.3	36.4	100.0	100.0

NA = not available.
1/ Suspended in 1974.

Sources: (1, 13).

Table 8--Pesticide use on U.S. soybeans 1/

Type of pesticide	Quantities used (active ingredient)		Share of total quantity	
	1971	1980	1971	1980
	Million pounds		Percent	
Herbicides:				
Alachlor	5.8	33.0	17.5	28.9
Trifluralin	5.5	26.2	16.6	22.9
Bentazon	NA	9.9	NA	8.7
Linuron	.8	3.6	2.4	3.1
Chloramben	8.6	4.9	25.9	4.3
Metribuzin	NA	7.3	NA	6.4
Vernolate	1.4	NA	4.2	NA
Naptalam	2.7	NA	8.1	NA
Others	8.4	29.5	25.3	25.7
Total	33.2	114.4	100.0	100.0
Insecticides:				
Carbaryl	1.3	2.1	25.5	26.2
Methomyl	NA	1.4	NA	17.5
Toxaphene	1.4	1.9	27.5	23.8
Methyl parathion	1.2	1.4	23.5	17.5
Others	1.2	1.2	23.5	15.0
Total	5.1	8.0	100.0	100.0

NA = not available.

1/ Represents 92 percent of U.S. soybean production and pesticide use.

Sources: (1, 12).

The major weed problem for corn growers was foxtail (including giant green, robust, and yellow foxtail species), which accounted for 35 percent of all weed control acre treatments in 1980 (table 9). The major insect problem on corn was the corn rootworm larva, which accounted for 70 percent of the corn insecticide acre treatments. Leading weeds in soybeans were foxtail and cocklebur, which accounted for 25 and 24 percent, respectively, of the soybean herbicide acre treatments. Leading soybean insect problems were corn earworm and armyworms

which combined accounted for nearly 60 percent of the soybean insecticide treatments.

Table 9--Major insect and weed species reported by U.S. corn and soybean growers, 1980

Species	Share of total acre treatments	
	Corn	Soybeans
	Percent	
Weed:		
Foxtail	35	25
Cocklebur	13	24
Velvet leaf	8	6
Quack grass	7	-
Pigweed	6	4
Ragweed	4	3
Crab grass	-	8
Johnson grass	-	8
Morning glory	-	3
Other	27	19
Total	100	100
Insect:		
Corn rootworm	70	-
Corn Borer	11	-
Corn earworm	-	30
Banks grass mite	6	-
Cutworm	4	4
Wireworm	3	-
Armyworm	-	29
Cabbage looper	-	8
Velvetbean caterpillar	-	6
Bean leaf beatle	-	4
Grasshopper	-	4
Other	6	15
Total	100	100

- = None.

Sources: (12, 13).

PEST CONTROL PRACTICES

Massive efforts to develop and use alternative pest control methods have been made in recent years because of pest resistance to pesticides, increasing chemical pest control costs, and potential hazards to human health and the environment. While employing these controls, farmers in general are becoming more conscious of the advantages of systematically managing pests, rather than indiscriminately using routine spray schedules.

Alternative Controls

Considerable research is devoted to expanding the use of biological controls as alternatives to chemical pesticides. Biological controls (or agents) have not received widespread interest from pesticide manufacturers because they are host specific, have limited profit potential, and often require different production and handling techniques from the companies' primary chemical operations. EPA is considering reduced testing requirements which could stimulate production by lowering development time to as little as 2.5 years at a cost of only $3 million for each material, compared with as much as $25 million for the average chemical pesticide currently in development. The patenting of biological compounds should stimulate genetic engineering firms to develop biological controls.

A program in Mississippi using biological agents (pathogenic virus and bacteria) to control bollworms and tobacco budworms in cotton was credited with cutting insecticide costs in half (7). These biological materials affect the digestive system of the insect pests without destroying beneficial insects. Researchers reported that if cotton growers could keep 15,000 to 20,000 beneficial insects per acre, they would take care of most of the worm populations (5).

Costs of some biological controls are reported at $25 per pound, less than the cost per pound for the average pyrethroid. Zoecon is attempting to develop an antijuvenile hormone which would accelerate an insect's transformation from its larval to pupae stage prematurely, thus killing or severely impairing its development (3). So far, this hormone has only shown effectiveness against the tobacco hornworm and not the more important cotton insect pests such as the cotton budworm and bollworm. The firm is further exploring ways to disrupt an insect's hormonal production by examining its nervous system. Biological agents which interfere with an insect's nervous system might apply to a greater array of insects.

Pheromones are compounds which are secreted by insects as sex attractants. Some of them have been synthetically produced and are receiving increasing attention from pest management researchers. They are an aid in luring insects into traps where sample numbers can be monitored by scouts. Pheromones

may also be used in conjunction with chemical pesticides. Confining the use of chemical pesticides to traps rather than as an application over the entire field has considerable promise in reducing pesticide use and environmental hazards.

Crop Management

Integrated crop management continues to receive growing support, with many farmers reporting improved yields and/or reduced pesticide use. Pest management has received the endorsement of EPA and private groups concerned about possible environmental damage from pesticides. USDA has devoted increased research and educational effort to this crop management approach.

Integrated crop management programs were originally spearheaded by USDA and the State extension services. Private consultants, dealers, and cooperatives have since entered the market, particularly in providing monitoring and advisory (scouting or field inspection for pest infestation) services. Some pesticide dealers are branching from strict retail sales to include pesticide mixing, application, and scouting. By diversifying, dealers can tailor their services to directly fit the farmer's needs. Currently, scouting is used more often for insect control than for weed control, since the latter depends largely on preemergence treatments. This is likely to continue until curative rather than preventative weed control is the common practice. A major reason for the increasing use of postemergence herbicides is the growing interest in reduced tillage and no-tillage practices. Postemergence herbicides are more adaptable for these practices and a number of good products are available or are being developed.

Tillage Practices

Reduced tillage practices have had a tremendous impact on pesticide demand. Use of no-till requires normal inseason weed control, plus the use of herbicides to kill existing vegetation prior to planting. Increasing energy costs and the need to conserve labor and equipment assure continued growth of these practices. From 1972 to 1981, reduced and no-till acreage more than doubled (16). Major no-till crops in 1980 included corn and soybeans, each at about 2 million acres. Reduced tillage land more than doubled between 1972 and 1980, with 26.0 million acres reported for corn and 13.5 million acres for soybeans in 1980 (12, 13). Major advantages of the reduced tillage programs are reduced erosion, moisture conservation, and reduced fuel, labor, and equipment costs. A drawback is the need for more chemical weed control and greater susceptibility to insect and disease infestations (8).

REGULATIONS

Registration is a costly process for both pesticide manufacturers and EPA. An EPA representative reports that it requires approximately 2 to 5 years of testing at a cost of up to $25 million to develop and register a new pesticide chemical (20). Many tests required by EPA, however, would be conducted by the manufacturers in any case in order to safeguard the product. To minimize regulatory costs, stimulate competitiveness in the market, and encourage new product development, EPA is examining the impact of regulations on manufacturers' production costs.

In an effort to streamline its activities, EPA has proposed to: 1) hold pre-registration conferences to head off problems concerning data and labeling requirements, 2) encourage voluntary agreements between EPA and registrants, 3) work more closely with State pesticide control agencies, 4) simplify registration standards which should result in simple guidance documents instead of lengthy dissertations and, 5) consider exempting specific products with nontoxic components from registration.

EPA is concerned with improving the scientific quality of the activities of the Office of Pesticide Programs and is proposing more peer review of studies critical to EPA in making decisions to cancel or restrict pesticides (17). All such EPA studies as well as controversial or unusual studies would be reviewed by the Scientific Advisory Panel (SAP).

High development costs for testing often discourage production of pesticides for specialized uses or local problems and other small markets where potential profits would not warrant registration by the manufacturer. To alleviate this problem, some "minor use" pesticides are not being required to meet all of the requirements specified for major crop pesticides. EPA has proposed some criteria to waive certain data requirements for minor uses. These include: (1) an annual volume of 25,000 pounds or less, (2) an exposure rate that is low or insignificant, or (3) a situation in which imposition of the data requirements would "result in de facto cancellation."

EPA is also introducing more flexibility in enforcing pesticide regulations by seeking negotiated settlements in restricting pesticide uses more often, and by issuing voluntary guidelines for registration instead of specific regulations. EPA would inform the industry of guidelines or expectations and may encourage discussion of various alternatives for meeting safety requirements.

Since exposure levels can be directly influenced by the applicator, EPA is proposing additional labeling requirements concerning use and more guidelines for applicator use of

pesticides reviewed in the Rebuttable Presumption Against Registration (RPAR) process and minor use situations. Proposed labeling requirements would instruct the user in proper application intervals, dosage rates, and use of protective clothing and respirators. With such measures, some toxic pesticides can be used with relative safety and need not be withdrawn from the market. This strategy, however, would not be a sufficient safeguard where pesticide use causes residues to remain in the environment.

The RPAR activity, a major program in the reregistration of questionable pesticide products, is continuing. However, regulatory options (final decisions on proposed actions as a result of the RPAR process) were issued for only one product in 1981, compared to 4 in 1980. Comprehensive cost benefit analysis, exposure analysis, and risk benefits assessments will continue despite reduced funding.

During the 5 years the RPAR program has been in effect, 21 proposed or final actions were taken. Of the 21 actions, 3 were initiated to cancel or suspend products: 2,4,5-T, silvex, and DBCP. For 10 of the 21 actions, EPA proposed to continue most of the major uses, subject to modification in formulation, use patterns, and packaging. For the other eight pesticides on which final RPAR action was taken, decisions to retain and cancel uses were about even (18).

While patent protection offers manufacturers an incentive for new product development, the registration process can delay product marketing several years. Proposals have been made to extend the life of the patent to compensate for the years lost in safety testing and registration (6). The additional period would give manufacturers time to recoup the high development and testing costs and encourage new product development. These proposals should also limit difficulties experienced with the data compensation features of current pesticide regulations.

LONG-TERM OUTLOOK

The U.S. pesticide market appears to have reached maturity. Several market analysts have projected a quantity demand growth rate to 1985 of only about 1 percent per year. Consumption in developing countries, however, is expected to increase by 4 to 5 percent yearly. Europe, which accounts for 20 percent of American exports, is not expecting market growth, with consumption there leveling off during 1980-85. Substantial growth is expected in Brazil, Mexico, Nigeria, and China. The Soviet Union, which is trying to boost agricultural production, should also experience a healthy growth in pesticide demand.

The herbicide portion of total U.S. pesticide consumption increased dramatically between 1966 and 1981. In coming years, however, consumption should stabilize or even decline, depending on crop acreages. The value of pesticides will nevertheless increase because of the complexity of new products and rising price levels.

An industry survey by Farm Chemicals magazine indicated a real annual growth rate of 5.6 percent for U.S. pesticide production during 1980-85. Further projections were that herbicides would grow 2.5 percent and insecticides 4.8 percent a year (table 10). The higher estimated real value growth rate as compared with the quantity estimates is due to the expected use of more complex products. According to this survey, the United States is expected to account for 46 percent of the world herbicide use, 24 percent of the insecticide use, 10 percent of the fungicide use, and 42 percent of the other pesticide use in 1985 (table 11). These are only very slight changes from 1980, except for a substantial increase in the relative use of other pesticides. The survey also projected

Table 10--Pesticide use, 1980 and projected 1985 1/

Type of pesticide	1980		1985		Annual percentage change 1980-85
	Value	Share of total	Value	Share of total	
	Million dollars	Percent	Million dollars	---Percent---	
United States:					
Herbicides	2,171	62	2,760	62	2.5
Insecticides	908	26	1,128	25	4.8
Fungicides	226	6	276	6	4.4
Other	199	6	319	7	12.0
Total	3,504	100	4,483	100	5.6
World:					
Herbicides	4,891	42	6,022	42	4.6
Insecticides	3,916	34	4,764	33	4.3
Fungicides	2,199	19	2,772	20	5.2
Other	559	5	758	5	7.1
Total	11,565	100	14,316	100	4.8

1/ Value for both years in terms of 1980 U.S. dollars.

Source: (11).

world pesticide expenditures at $14.3 billion by 1985 (1980 base) compared with $11.6 billion in 1980 (table 10). U.S. use was projected at $4.5 billion in 1985, compared with $3.5 billion in 1980.

Table 11--U.S. share of world pesticide use, 1980 and projected 1985 1/

Type of pesticide	1980	Projected 1985
	Percent	
Herbicide	45	46
Insecticide	23	24
Fungicide	10	10
Other	36	42
Total	30	31

1/ Based on 1980 U.S. dollars.

Source: (11).

About 70 percent of the herbicides in the United States in 1980 were used on corn and soybeans, while the share in the rest of the world was less than 20 percent (table 12). In the United States, 27 percent of the insecticides were used on corn; only 6 percent of the insecticides in the rest of the world were used on this crop.

Although there are about 50 basic producers, 14 firms account for 85 percent of total production. The introduction of new complex pesticides entailing high development costs is likely to further increase industry concentration.

Extended patent protection and expedited registration requirements should encourage new product development and may increase the obsolescence rate of existing pesticide products. The encouragement of new pesticide development could also accelerate

Table 12--Use of herbicides, insecticides, and fungicides by crop, U.S. and the rest of the world, 1980

Type of pesticide and crop	United States		Rest of world	
	Expenditures	Share of total	Expenditures	Share of total
	Million dollars	Percent	Million dollars	Percent
Herbicides:				
Corn	754	35	323	12
Soybeans	749	34	164	6
Cotton	142	7	179	7
Wheat	97	5	525	19
Rice	53	2	376	14
Other	376	17	1,153	42
Total	2,171	100	2,720	100
Insecticides:				
Corn	242	27	176	6
Cotton	212	23	706	23
Rice	11	1	552	18
Soybeans	33	4	96	3
Fruits and nuts	155	17	505	17
Vegetables	107	12	321	11
Other	148	16	652	22
Total	908	100	3,008	100
Fungicides:				
Wheat	7	3	265	13
Rice	5	2	303	16
Other grains	5	2	102	5
Fruits and nuts	81	36	719	36
Vegetables	38	17	301	15
Other	90	40	283	15
Total	226	100	1,973	100

Source: (11).

the turnover among leading firms. Such shifts are likely to be confined mostly to firms already established in the market, rather than to new firms. Several foreign firms have entered the industry in recent years by acquiring U.S. operations. Some of the acquiring firms are progressive companies and should greatly enhance industry competition. Several Japanese pesticide manufacturers are moving into the major U.S. markets for cotton, corn, soybeans, wheat, and rice. Since these firms generally lack the marketing network necessary for large scale American distribution, many are engaging in joint licensing arrangements with domestic manufacturers.

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